ABSTRACT

Advance development in security technology has caused many major corporations and governments to start employing modern techniques in identifying the identity of the individuals. Among the common biometric identification methods are facial recognition, fingerprint recognition, speaker verification and so on, present a new solution for applications that require a high degree of security. Among these biometric methods, iris recognition becomes an important topic in pattern recognition, and it depends on the iris which is located in a place that still stable through human life. Furthermore, the probability to find two identical iris's approaching to zero value is quite easy. The identification system consists of several stages, and segmentation is the most crucial step. The current segmentation methods still have limitation in localizing the iris due to circular shape consideration of the pupil. Therefore, in this research, two segmentation methods of iris are suggested: Daugman method and Gupta method to investigate the feasibility of these segmentations in iris recognition. An enhanced method based on the techniques of the mentioned two methods is proposed, which can guarantee the accuracy of the iris identification system. The proposed method takes into account the elliptical shape of the pupil and iris. Eyelid detection is another step that has been included in this study as a part of segmentation stage. The dataset which is used for the study is CASIA v3 including the three subsets: Interval, Lamp and Twin. The performance measurement of the proposed method is done by determining the number of success images. The results of the study are very promising with an accuracy of 99.9% compared to the related existing methods.

ABSTRAK

Pembangunan lanjutan dalam bidang teknologi keselamatan telah menyebabkan banyak syarikat yang besar dan juga sektor kerajaan mengorak langkah untuk menggunakan kaedah-kaedah moden bagi mengenalpasti identiti individu-individu yang berkaitan. Antara kaedah-kaedah pengenalpastian biometrik yang sering digunapakai adalah pengecaman wajah, pengecaman cap jari, pengesahan suara dan sebagainya, yang berupaya menyajikan suatu penyelesaian baru untuk aplikasi yang memerlukan tahap keselamatan yang tinggi. Pengecaman iris merupakan salah satu kaedah biometrik yang sering menjadi topik penting dalam pengecaman pola. Ini adalah kerana ia bergantung kepada kedudukan yang tetap dan stabil dalam jangka hayat manusia. Tambahan pula, kebarangkalian untuk mencari dua identiti iris yang serupa untuk menghampiri nilai sifar adalah agak mudah. Sistem pengenalpastian terdiri daripada beberapa fasa, dan fasa segmentasi merupakan fasa yang paling penting. Kaedah segmentasi terkini masih mempunyai kekangan dalam penempatan iris disebabkan oleh rupabentuk lingkaran anak mata hitam. Oleh yang demikian, kajian ini mencadangkan dua kaedah segmentasi iris: kaedah Daugman dan kaedah Gupta untuk mengkaji kesauran teknik segmentasi terhadap pengecaman iris. Penambaikan kaedah segmentasi bagi kedua teknik tersebut dilaksanakan bagi menjamin ketepatan sistem pengenalpastian iris. Kaedah yang dicadangkan mempertimbangkan anak mata hitam dan iris yang berbentuk elip. Pengesanan kelopak mata merupakan langkah selanjutnya dalam fasa segmentasi. Set data yang digunakan dalam kajian ini adalah CASIA v3 dengan tiga subset yang lain: Jeda, Lampu dan *Twin*. Pengukuran prestasi terhadap kaedah cadangan bergantung kepada bilangan imej yang berjaya dikesan. Hasil dapatan kajian adalah memberangsangkan dengan ketepatan adalah 99.9% berbanding dengan kaedah sedia ada yang setara.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Overview

Biometric identification methods, including facial recognition, fingerprint recognition, speaker verification and so on, present a new solution for applications that require a high degree of security. Among these biometric methods, iris recognition becomes an important topic in pattern recognition.

The iris is known as the thin colored area, which is located between the cornea and the lens of the human's eye. Its center is closed by a part known as the pupil (Daugman, 2004).

In comparison among biometrics, iris identification systems will gain a good result. Iris texture has a very high degree of freedom and that make it extremely important. What's more, the chance of finding two person have the same identical irises is close to zero and most iris patterns remain stable over the life time.

Therefore, the iris identification system is the most reliable among other identification systems and for sure it can be useful in many secure places (Park H.A. et al., 2007).

A standard iris identification system consists of four stages: acquisition, preprocessing, feature extraction and matching (Miyazawa K. et al., 2008). Preprocessing combines three steps: segmentation, normalization and enhancement. Acquisition is the process of getting the image from the source using a particularly designed device for this purpose. Preprocessing is used to enhance the captured image and prepare it for the next stage which is feature extraction .Eventually, matching is performed to check wither the current features that has been extracted has a match with the existing features of candidate iris to identify the identical iris (Yu, L. et al., 2007).

Iris segmentation is the most important and serious step in the iris identification system. It is to localize the exact iris area image from the human eye image. The output of this stage is very important and has played a primary role in the steps after segmentation (normalization, enhancement, feature extraction and matching). The efficiency of iris identification system is primarily dependent on the accurate output of iris segmentation (Kim J. et al., 2004).

The iris segmentation role is to identify the iris region in the eye image as seen in Figure 1.1.

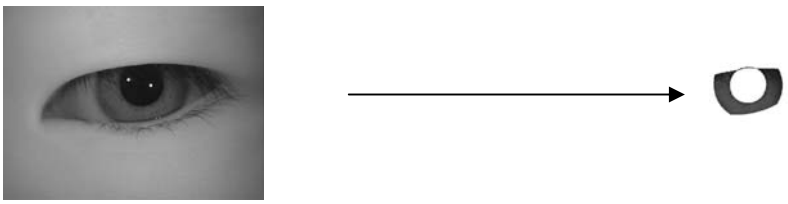

Figure 1.1: An iris segmentation stage

Therefore, in this research the concentration will be on iris segmentation stage by studying two methods of iris segmentation which will be Daugman and Gupta.

In addition, an enhanced method will be applied to include the whole iris by considering the elliptical shape of the iris.

1.2 Problem Background

As mentioned above, Iris identification system consists of several steps, segmentation step is the most important step among these steps .Furthermore, it plays a significant role in iris identification systems especially in determining the pupil of the eye then the IRIS. Related to this subject, researchers exerted effort with hope to segment iris in accurately**.**

Daugman (1993, 2001, and 2007) proposed the Integro-differential operator (IDO), which actually treated the pupil and limbus of the iris as a circular shape and trying to detect these boundaries by yielding a search for large circular variations in the image**.** By changing the contour path from circular to a designed accurate, IDO also detects the upper and lower eyelid boundaries.

Wei Li et al**.** (2009) introduced a method to segment iris which was based on rotation average analysis of intensity-inversed image. The method segmented the inner boundary and fitted the outer boundary (both as a circle) by least-square non-linear circular regression**.**

Rahib, Hidayat Abiyev et al. (2009) proposed an algorithm to detect the boundaries between the both pupil and iris and sclera and iris. A technique called rectangular area is applied in order to find the pupil and detect the inner circle of iris and after that detect the outer boundary of it.

A Circle Density Based Iris Segmentation method (CDIS) has been proposed by Gupta Anand (2009) .It consists of specular reflection deduction, eyelash elimination and Iris segmentation along with eyelid removal based on the local image statistics and block intensity.

Dae Sik Jeong, et al. (2010) proposed a method based on the adaptive boosting eye detection algorithm (AdaBoost), which is an algorithm that constructs a strong classifier by coupling the weak classifiers), in order to balance the iris detection errors caused by two circular edge detection operations.

Most iris segmentation techniques assume that the boundary of pupil and iris as a circle, but the boundary of them is not quite circle and a small error in detecting the boundary of iris will lead to lose some information that is exist around the iris.

Furthermore, there are a lot of challenges that should be overcome by proposing an enhanced segmentation method that can yields precise results as input to the identification system to enhance its efficiency.

1.3 Problem Statement

Though, the captured image of eye contains the iris, it also contains data resulting from the surrounding eye region like sclera, eyelid and eyelashes and pupil. Therefore, it is extremely important to segment and localize the iris from the captured image, before feature extraction and matching stages. Thus, the totally performance of iris identification system is evaluated by the fact that how precise iris is segmented and localized from a original captured image of the eye (Kong W.K, et al., 2001).

As mentioned before, most presented methods above considered the boundary of iris is a circle, whereas in fact, this boundary is not quite circle. Therefore the error in detecting the iris will lead to lose some information which is existence around it. This problem in pupil boundary detection will affect the iris segmentation significantly. As a result, the performance of iris recognition system will be very poor.

The false detection due to noises such as strong boundaries of upper and lower eyelids is another problem will lead to poor performance for iris recognition system.

1.4 Research Aim

The main aim of this research is to study two iris segmentation methods which are Daugman and Gupta and propose an enhance method for iris segmentation based on

the techniques that has been used in the mentioned methods with taking into account the circular shape of iris .

These enhancements or investigations will be done in accordance with what have been found by other researchers in this field, even though it is still very new area of research and there is only very small number of researches on this subject.

1.5 Objectives

The objectives of this research are:

1. To study and investigate two IRIS segmentation methods (Gupta and Daugman) and explore the segmentation results.

2. To propose an enhanced and effective method for iris segmentation that can reduce the potentiality of losing pixels and image quality due to image processing techniques to guarantee the accuracy.

3. To implement the proposed segmentation method and evaluate its results with the investigated methods.

1.6 Research Scope

The scopes of this study are defined as follows:

1. In this research, two methods of iris segmentation have been studied just in segmentation stage (Daugman method and Gupta method).
2. The proposed enhanced method was based on choosing the best techniques of two existing methods of segmentation (Daugman and Gupta) and using image processing techniques.
3. Dataset that has been employed was: CASIA v.3.
4. The experiments was done by MATLAB

1.7 Significance of the Research

In this research, some methods in iris segmentation based on image processing techniques will be studied and the best method that can guarantee the accuracy of the image to increase the performance of iris recognition system will be applied.

1.8 Organization of the Thesis

This thesis consists of five chapters. The first chapter presents introduction to the iris segmentation and the background of problem on why the study is being conducted. It also gives the problem statement, the objectives and the scope of the study. Chapter 2 reviews on iris segmentation methods and discusses the previous work related to the problem under discussion. Chapter 3 discusses on the study methodology used in this study. It explains the details of proposed methodology to enhance the segmentation method. Chapter 4 explores the experimental result and analysis. Chapter 5 is the conclusion and suggestion for future work.